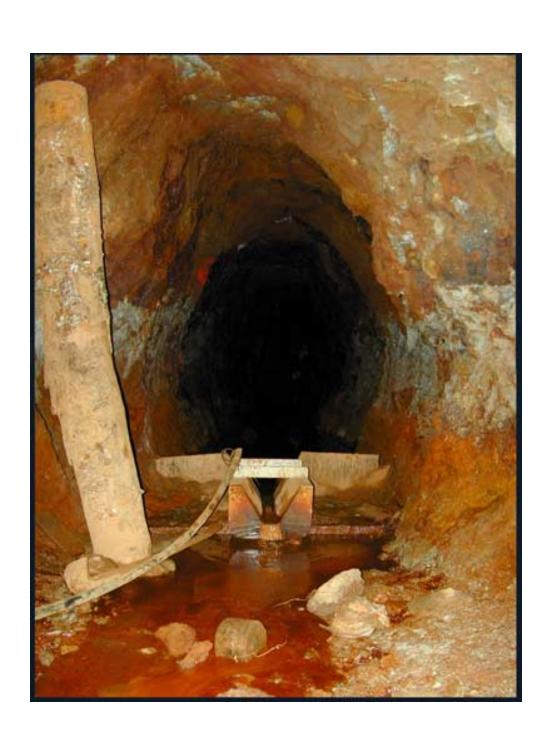


Performing Quality Flow Measurements at Mine Sites



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by

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NOTICE

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FOREWORD

The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threatens human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

E. Timothy Oppelt, Director National Risk Management Research Laboratory

ABSTRACT

Accurate flow measurement data is vital to research, monitoring, and remediation efforts at mining sites. This guidebook has been prepared to provide a summary of information relating to the performance of flow measurements, and how this information can be applied at mining sites. Information presented in this guidebook includes the theory, methods, selection criteria for these methods, and quality assurance/quality control (QA/QC) guidance for performing flow measurements at mining sites.

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LIST OF ACRONYMS

ADCPs Acoustic Doppler Current Profilers
ADVs Acoustic Doppler Velocimeters

AVM Acoustic Velocity Meter
BMPs Best Management Practices
BOR Bureau of Reclamation

CAA Clean Air Act

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

cfs Cubic Feet per Second cms Cubic Meters per Second

CWA Clean Water Act EGL Energy Grade Line

EPA U.S. Environmental Protection Agency

FSs Feasibility Studies ft/s Feet per Second ft² Square Feet

gpm Gallons per minute
HGL Hydraulic Grade Line
l/s Liters per Second

LDVs Laser Doppler Velocimeters

LiBr lithium bromide

MDLs Method Detection Limits

MWTP Mine Waste Technology Program

NaBr Sodium Bromide NaCl Sodium Chloride

NEPA National Environmental Policy Act

NPDES National Pollutant Discharge Elimination System
NRCS U.S. Natural Resource Conservation Service
NRMRL National Risk Management Research Laboratory

QA Quality assurance

QA/QC Quality Assurance/Quality Control
QAPP Quality Assurance Project Plan

QC Quality Control

LIST OF ACRONYMS (continued)

RI/FS Remedial Investigations/Feasibility Studies

RIs Remedial Investigations
RPD Relative Percent Difference
RSD Relative Standard Deviation
SCS Soil Conservation Service

SME Society of Mining Metallurgy and Exploration

TMDL Total Maximum Daily Loads USGS United States Geological Survey